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The burden of COPD in the U.S.A.: results from the Confronting COPD survey

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Abstract Chronic obstructive pulmonary disease (COPD) is a progressive disorder of airflow limitation that is not fully reversible, with disabling symptoms including chronic cough and dyspnoea. Although a number of studies in the U.S.A. have assessed the impact of COPD on the healthcare system and society, data on healthcare resource utilization (particularly outpatient services and medication use) in patients with mild to moderate COPD, or patients who meet symptom criteria for COPD but have not received this diagnosis, are limited or unavailable. To fill gaps in current knowledge about the impact of this disease, an economic analysis was conducted on the data collected from patients enrolled in the U.S.A. sample of *Confronting COPD in North America and Europe*, the first large-scale international survey of the burden of the disease. The annual cost of healthcare resource utilization was estimated at US$4119 per patient with COPD, with indirect (non-medical care) costs amounting to US$1527 per patient. The annual estimated societal cost was therefore US$5646 per patient. The majority of disease costs in the survey were associated with inpatient hospitalizations (US$2891). The results of the survey suggest that interventions that improve COPD outcomes by decreasing symptoms and preventing acute exacerbations could substantially decrease the costs associated with this disease.

Keywords chronic obstructive pulmonary disease (COPD), direct costs, indirect costs, hospitalization, comorbidity, U.S.A., survey

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a progressive disorder of airflow limitation that is not fully reversible, with disabling symptoms including chronic cough and dyspnoea. In the U.S.A. in 2000, approximately 10 million adults responding to the National Health Interview Survey reported a diagnosis of COPD (1). The self-reported prevalence rate of physician-diagnosed chronic bronchitis and emphysema was estimated at 60 per 1000 of the population, with a higher proportion of women affected than men (45·5 per 1000 versus 73·2 per 1000 people). However, data from the third National Health and Nutrition Examination Survey (NHANES III) showed that 24 million adults (13·5 million men, and 10·5 million women) had mild or moderate obstructive lung disease, suggesting that COPD is significantly under-diagnosed in this country (1).

COPD is a serious health problem in the U.S.A. Mortality from COPD increased by 40% between 1979 and 1998, rising from 14·0 to 19·9 deaths per 100 000 of the general population, and becoming the fourth leading cause of death (exceeded only by heart attack, cancer and stroke) (2). COPD-related illness places a significant burden on the healthcare system, with an estimated direct cost of US$1522 per patient per year, three times the per patient cost of asthma (3). The burden of COPD is particularly high in secondary care, with over 660 000 hospital discharges for COPD recorded in 1998 (4). The annual cost of hospital care for COPD in the U.S.A. was estimated at US$7·3 billion in 2000, 40% of the total direct (medical care) cost of the disease (US$18·0 billion) (5). Much of the cost of hospital care for COPD arises from the management of acute exacerbations of the disease, with inpatient stays being the primary cost driver (6).

The cost of COPD in the U.S.A. has been shown to rise with disease severity. The cost of treating a patient with severe COPD has been estimated at US$10812 per year, compared with US$1681 for a patient with mild disease and US$5037 for a patient with moderate disease (7). The direct cost of COPD also increases with the duration of smoking history; estimates of direct medical costs for 1·3 million patients with COPD from the 1987 US National Medical Expenditure survey showed that healthcare expenditures were higher in COPD patients with ≥50 pack-year smoking history (US$7212 per patient per year) than in COPD patients

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who had smoked for <50 pack years (US$6642), or had never smoked (US$6317) (8).

In addition to direct costs, COPD has been shown to have a significant impact on non-medical costs (e.g. workplace costs) in the U.S.A. The total cost of lost productivity due to COPD in this country was estimated at US$14·1 billion in 2002, bringing the total societal cost of the disease to an estimated US$32·1 billion (5).

Although a number of studies in the U.S.A. have assessed the impact of COPD on the healthcare system and society, most studies have been based on patients diagnosed with COPD (in particular, those with severe disease), or specific groups of patients receiving treatment under the provision of individual healthcare plans (9). Data on healthcare resource utilization (particularly outpatient services and medication use) in patients with mild to moderate COPD, or patients who meet symptom criteria for COPD but have not received this diagnosis, are limited or unavailable. To fill gaps in current knowledge about the impact of this disease, an economic analysis was conducted on data collected from patients in the U.S.A. responding to the *Confronting COPD in North America and Europe* survey, the first large-scale international survey of the burden of the disease. The survey included patients with physician diagnosed and undiagnosed COPD, and collected information on healthcare resource utilization and direct costs, as well as indirect costs resulting from COPD-related patient work absence. This paper reports the results of the economic analysis of the U.SA. data. Results from other countries participating in the survey are presented elsewhere (10–15).

METHODS

Survey methods

The methodology of the Confronting COPD survey is described in detail elsewhere (16–17). In summary, telephone interviews were conducted with 3265 patients and 905 physicians from the U.S.A., Canada, France, Germany, Italy, the Netherlands, Spain and the U.K., to collect information about the country-specific burden of COPD. In all countries except Germany, quantitative measures of healthcare resource utilization and work loss were derived from responses to the patient questionnaire, and used to estimate the direct, indirect and societal per patient costs of COPD for the 1-year period prior to the initiation of the survey. A sub-analysis was also conducted to investigate relationships between the COPD costs and self-reported disease severity, gender, smoking status, comorbidities and education level.

Unit costs

Unit costs used in the economic analysis of data from Confronting COPD survey in the U.S.A. are shown in Table 1 (7). Costs for time lost from work were applied to patients up to the mean age of retirement (62·0 years for men and 61·4 years for women) (18).

RESULTS

Patient demographics

The characteristics of the patient sample enrolled in the Confronting COPD survey in the U.S.A. are shown in Table 2.

Patients ranged from 42–89 years of age, and 55·3% were female. All patients in the sample were current (42·7%) or former smokers (57·3%), and the mean smoking history for the patient sample was 52 pack years (range 0–310 pack years); 9% of patients in the survey did not report having physician-diagnosed COPD, but reported chronic bronchitis as defined by persistent coughing with phlegm or sputum production for the last 2 years or more. The majority of patients (70%) considered their condition to be mild or moderate at the time of the survey. Over half (57%) of the patients had serious or chronic health conditions other than COPD. The most commonly reported comorbidities were heart disease (15%), hypertension (11%), arthritis (11%) and diabetes (8%).

Healthcare professional contacts and hospital visits

Two-thirds (68%) of patients surveyed normally visited a primary care practitioner (PCP) for the management of their condition. The percentage of patients who reported scheduled and unscheduled contacts with healthcare professionals for COPD is shown in Fig. 1. A mean of 4·6 scheduled PCP visits per patient were reported during the year prior to the interview, and 8% of the total number of PCP visits were reported as unscheduled care visits (mean 0·41 per patient) (Table 3). The maximum number of unscheduled visits by any one patient was 15.

One-third (32%) of the patients with COPD in the U.S.A. sample were receiving treatment from a specialist (pulmonary specialist, allergist, cardiologist or other) in primary or secondary care. Unscheduled visits to a specialist were reported by only 4% of patients (Fig. 1), but accounted for 13% of the total number of specialist contacts, with a mean of 0·27 unscheduled specialist visits per patient (Table 2). One-fifth (20%) of the patients contacted a pulmonary specialist at least three times in the year prior to the survey.

One-third of patients enrolled in the Confronting COPD survey in the U.S.A. had been hospitalized at some time in their lives due to COPD. One in seven patients reported an inpatient stay during the 12 months prior to the survey (Fig. 1), with a mean of 0·38 hospitalizations per patient (Table 3). One-fifth (21%) of

Table 1. Unit costs used in the economic analysis of Confronting COPD in the U.S.A.

Unit	Cost (US$)
Healthcare resource use/contacts	
Primary care practitioner (PCP) visit	$45
Specialist visit	$85
Inpatient hospitalization	$7690
Emergency room (ER) visit	$554
Treatment for COPD	
Prescribed medication per year	
Anticholinergic	$41·35
Inhaled corticosteroid	$54·35
Leukotriene receptor antagonist	$6·45
Short-acting β_2-agonist	$48·84
Systemic corticosteroid	$16·30
Theophylline	$6·45
Other	
Course of antibiotics (primary care or emergency room/during inpatient stay)	$192·49/$81·89
Influenza vaccine	$8·50
Home oxygen use per day (concentrator/cylinder)	$0·53/$0·38
Laboratory tests (7)	
Chest X-ray	$45
Computerized tomography (CT) scan*	$965
Electrocardiogram (ECG)	$29
Finger stick/hypodermic test of blood oxygen	$12·06/$3
Work loss	
Males or females aged 45 years to retirement age, per day	$100·55

*Cost also applied to computerized axial tomography (CAT) or magnetic resonance imaging (MRI) scan

Table 2. Patient demographics and clinical characteristics

n	447
Female	55·3%
Mean age in years (SD±)	64·08
Current smokers	42·7%
Mean pack-year smoking history (SD±)	51·9 (40·5)
Primary diagnosis:	
Emphysema	37%
COPD	32%
Chronic bronchitis	22%
Undiagnosed	9%
Self-assessed severity of COPD	
Mild	32%
Moderate	38%
Severe	25%
Disease severity as assessed by the Medical Research Council Dyspnoea Scale	
Mild	40%
Moderate	52%
Severe	7%
Self-perceived level of disease control	
Completely or well controlled	34%
Somewhat or poorly controlled	59%
Not controlled at all	6%
Diagnosed with other serious or chronic health conditions	57%
Educated beyond high school	67%

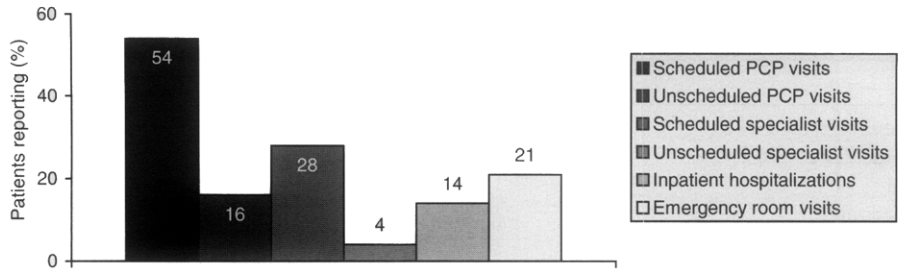

FIGURE 1. Percentage of patients reporting (≥1) category of healthcare resource use during the 12 months prior to the survey.

Table 3. Hospital visits and healthcare professional contacts for COPD during the 12 months prior to the survey

Healthcare resource use/contacts	Total no. of hospitalizations/visits	No. per patient (*n*=447)	
		Mean (SD±)	Range (min, max)
PCP visits			
Scheduled	2026	4·55 (9·26)	0, 52
Unscheduled	184	0·41 (1·26)	0, 15
Specialist visits			
Scheduled	672	1·51 (3·12)	0, 12
Unscheduled	106	0·27 (2·12)	0, 35
Inpatient hospitalizations	168	0·38 (1·78)	0, 30
Emergency room visits	233	0·52 (1·81)	0, 30

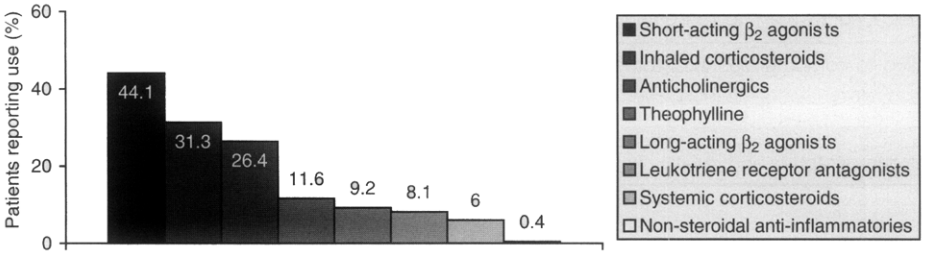

FIGURE 2. Percentage of patients reporting use of ≥1 class of prescribed medication.

patients reported a visit to the emergency room for the treatment of COPD (Table 3), with a mean of 0·52 visits per patient.

Treatment for COPD

Around two-thirds (67%) of patients in the U.S.A. sample were taking prescribed medication for the treatment of COPD. Short-acting β_2-agonists (44%), inhaled corticosteroids (31%) and anticholinergics (26%) were prescribed most frequently (Fig. 2). Two-fifths (40%) of patients had a nebulizer for the administration of bronchodilator medication. More than half of the patients had received antibiotics for respiratory infections (Table 4). One-quarter (24%) of the patients had used home oxygen therapy for COPD in the last 12 months with total usage over the previous year estimated to be 34 620 days (72·58 days per patient). In addition, three-fifths (60·4%) had an influenza vaccination in the past year.

Diagnostic tests and procedures

In the U.S.A. sample, a mean of 2·3 diagnostic tests and procedures (chest radiography, electrocardiograph (ECG), computerized tomography (CT) scan, magnetic resonance imaging (MRI) scan, blood oxygen assessment) were conducted per patient (Fig. 3, Table 5). Two-thirds of patients reported at least one chest radiograph, and more than two-fifths of patients reported getting at least one ECG, or a blood oxygen level assessment with a finger stick test or hypodermic needle/syringe test. A quarter of patients reported having at least one CT or MRI scan.

Table 4. Antibiotics and oxygen use reported by patients with COPD during the 12 months prior to the survey

Treatment	No. (%) of patients reporting	Mean per patient reporting	Per patient (*n*=447) Mean (SD±)	Per patient (*n*=447) Range (min, max)
Course of antibiotics for respiratory infections	243 (54%)	1·7	0·93 (3·06)	0, 48
Days of home oxygen usage	115 (26%)	301·0	77·45 (147·08)	0, 365

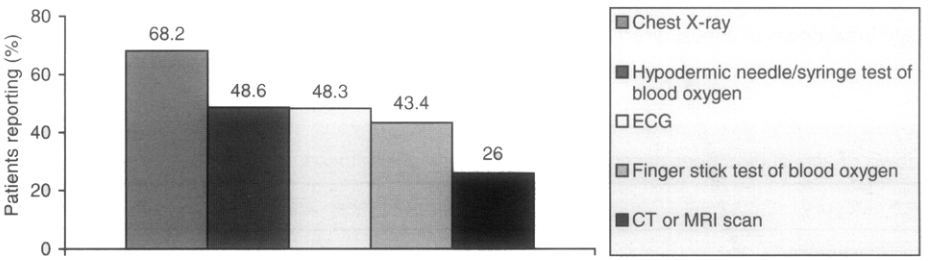

FIGURE 3. Patients reporting at least one laboratory test for COPD during the 12 months prior to the survey.

Table 5. Laboratory tests for COPD during the previous year

Laboratory test	Total no. of tests conducted	Per patient (*n*=447) Mean (SD±)	Per patient (*n*=447) Range (min, max)
Chest X-ray	578	1·29 (3·36)	0, 60
CT, CAT or MRI scan	116	0·26 (0·44)	0, 1
ECG	65	0·14 (0·83)	0, 15
Finger stick test of blood oxygen	194	0·43 (0·50)	0, 1
Hypodermic needle/syringe test of blood oxygen	486	1·09 (3·39)	0, 60

Work loss due to COPD

One-third (34%) of patients reported that they were prevented from working because of their COPD. Almost one-fifth (18%) of patients were limited in their ability to work normally, and 6% of patients (*n*=25) missed time from work due to COPD. Over the previous year, the total number of work days lost by patients was estimated at 6838 days (18·7 days per patient of working age). Work loss among the caregivers of patients with COPD was reported by 7% of respondents, with a total of 54 days lost (mean of 1·7 days per caregiver reporting work loss).

Direct costs

The annual cost of healthcare resource utilization was estimated at US$4120 per patient with COPD. The highest per patient cost of any individual healthcare resource was for inpatient hospitalizations, which was estimated at US$2891·00 and accounted for over 70% of the total direct costs of COPD. When the cost of emergency room visits and unscheduled contacts with a PCP or specialist was added to inpatient costs, the estimated cost of these unscheduled care visits accounted for 78% of the total per patient cost of COPD to the U.S.A. healthcare system (Fig. 4). It was estimated that less than 10% of direct per patient costs were for scheduled care visits, treatment for COPD (including regular prescribed medication use, courses of antibiotics, influenza vaccination and oxygen therapy), or laboratory tests.

Table 6 provides a summary of the estimated per patient costs by healthcare resource measure. The mean cost of inpatient hospitalization (US$2891, SD ± US$13697) was over 12 times higher than the mean cost of PCP visits (US$225, SD ± US$428) and 14 times higher than the mean cost of specialist contacts for COPD (US$204, SD ± US$416). The cost of treatment for COPD was estimated at US$242 per patient (SD ± US$56), with 59% of costs for antibiotics.

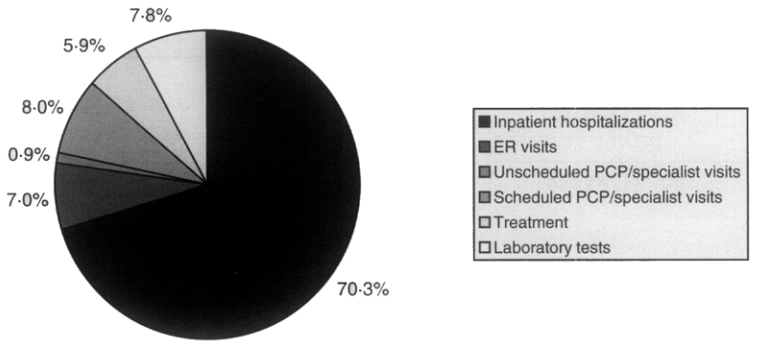

FIGURE 4. Percentage breakdown of annual direct costs of COPD for the U.S.A. sample.

Table 6. Breakdown of annual direct per patient costs by category of healthcare resource use

Healthcare resource category	Estimated mean annual cost per patient in US$ (SD±) (*n*=447)	
Healthcare resource use/contacts		
PCP visits		
Total	$225·19	($428·29)
Scheduled	$203·99	($415·78)
Unscheduled	$18·48	($56·92)
Specialist visits		
Total	$150·20	($295·65)
Scheduled	$127·79	($264·92)
Unscheduled	$18·44	($77·14)
Inpatient hospitalizations	$2891·00	($13697·00)
Emergency room visits	$289·10	($1002·80)
Treatment for COPD		
Prescription medication		
Anticholinergics	$10·92	($18·25)
Inhaled corticosteroids	$17·02	($25·24)
Leukotriene receptor antagonist	$0·52	($1·76)
Long-acting β_2-agonists	$2·21	($6·98)
Non-steroidal anti-inflammatories	$0·00	($0·02)
Short-acting β_2-agonists	$21·52	($24·27)
Systemic corticosteroids	$0·98	($3·89)
Theophylline	$0·53	($1·47)
Other		
Antibiotics for respiratory infections	$142·74	($426·49)
Influenza vaccines	$5·13	($4·16)
Home oxygen therapy	$40·33	($77·40)
Laboratory tests		
Chest X-rays	$58·22	($151·13)
CT or MRI scans	$250·43	($423·50)
ECGs	$4·18	($24·19)
Finger stick tests of blood oxygen	$5·23	($5·98)
Hypodermic needle/syringe tests of blood oxygen	$3·26	($10·18)
Total direct cost	$4119·73	($15303·58)

Use of regular prescription medication was associated with only one-fifth (22·2%) of the estimated treatment costs, and only 1·3% of the estimated total direct cost of COPD per patient.

Societal costs

The indirect cost of COPD was calculated from work loss and was estimated at US$1527 per patient. Adding this to the direct cost of the disease gave an estimated

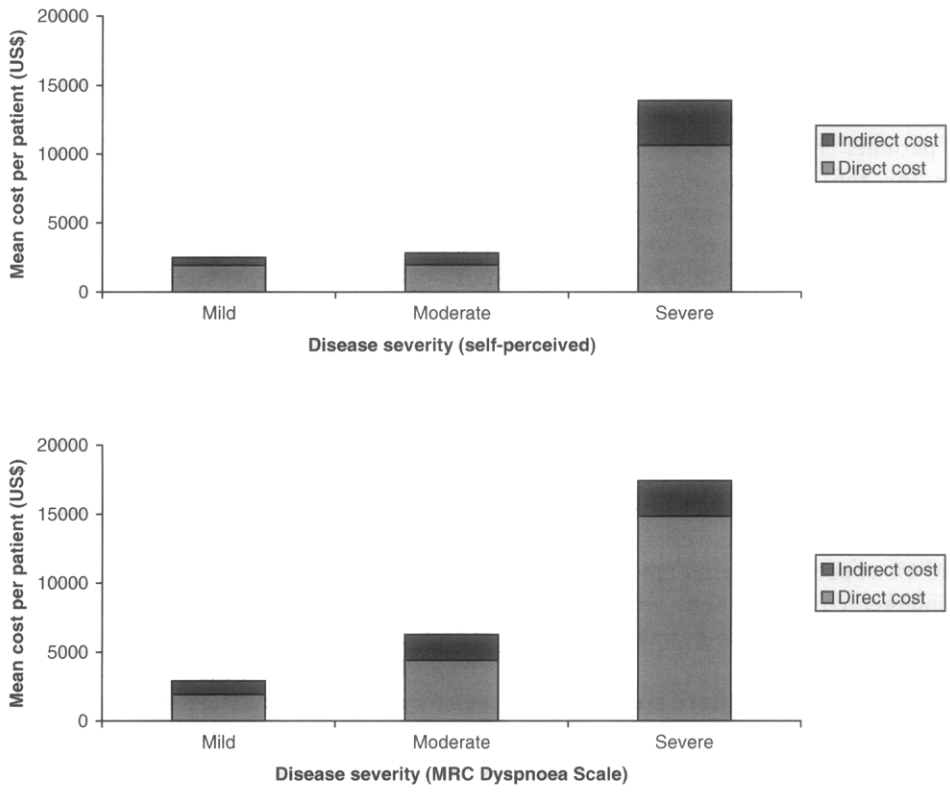

FIGURE 5. Annual societal costs of COPD by disease severity.

Table 7. Direct, indirect and societal costs of COPD by demographic category

		Mean cost per patient (US$)		
Category	Group (*n*)	Direct	Indirect	Societal
Sex	Female (247)	$4699	$1624	$6323
	Male (200)	$3403	$1408	$4810
Smoking status	Former (256)	$4582	$1534	$6116
	Current (191)	$3499	$1518	$5017
Comorbidities	Yes (255)	$4175	$1781	$5956
	No (192)	$4046	$1190	$5235
Education	High school only (49)	$4201	$2052	$6253
	Beyond high school (390)	$4137	$1493	$5629

societal cost of US$5646 (of which 73% was direct costs and 27% was indirect costs).

Associations between costs and patient variables

A sub-analysis of costs was conducted in patient groups stratified by disease severity, either self-perceived or assessed in terms of scores on the Medical Research Council Dyspnoea Scale (19) (score 0–2: mild COPD, score 3–4: moderate COPD, score 5: severe COPD). The results showed that severe COPD was associated with considerably higher annual societal costs per patient than moderate or mild COPD (Fig. 5). Further analysis of costs by demographic category showed that the direct, indirect and societal costs of COPD per patient were particularly high in female patients, former smokers, patients with comorbidities, and patients with no education beyond high school (Table 7).

DISCUSSION

The Confronting COPD survey provides an estimate of the impact of COPD, in terms of healthcare resource utilization and work loss. These estimates were used to calculate the societal cost of the disease. Patients enrolled in the study had been diagnosed with COPD, chronic bronchitis or emphysema, or had symptoms

consistent with the chronic bronchitis (persistent cough or sputum production for at least 2 years prior to the survey).

The results from the U.S.A. sample showed that two-thirds of patients normally saw a primary care practitioner for the everyday management of their condition. Almost one-third of patients were receiving specialist care, the majority of which had seen a respiratory specialist a number of times in the previous year. One-third of patients had been hospitalized for COPD at sometime in their lives, and one-fifth of patients had visited the emergency room at least once in the last 12 months. The estimated annual direct cost of COPD was considerable, at over US$4100 per patient. As well as having an impact on the healthcare system, COPD-related illness and disability prevented one-third of patients under retirement age from working, and 6% of patients missed time from work. The estimated indirect cost of patient work loss totalled US$1527 per patient, over one-quarter of the societal costs of COPD.

The majority (70%) of healthcare costs in the survey were associated with inpatient hospitalizations. Other forms of unscheduled care for COPD (emergency room visits, contacts with primary care practitioners or specialists) contributed another 8% to the direct cost of the disease. Unscheduled visits and hospitalizations may reflect poor symptom control, particularly the treatment of worsening symptoms during acute exacerbations. These results suggest that the burden of COPD on the healthcare system could be reduced by shifting the focus of care away from the acute management of symptom exacerbations, towards improving the long-term management of the disease in primary care, with the aim of preventing exacerbations and reducing the risk of COPD-related hospitalization.

National and international treatment guidelines outline a number of goals for the treatment of COPD in primary care, including the prevention of exacerbations and controlling symptoms with appropriate medication. However, the results of this U.S.A. survey suggest that these goals are not being achieved in many patients. Although 91% of patients with COPD reported a physician diagnosis of the disease, one-third of patients were not receiving regular prescribed medication, and two-thirds of patients reported that their condition was only somewhat or poorly controlled. Over half of the patients had received antibiotics for respiratory infections in the previous year, which may suggest that exacerbations were a common occurrence. These results highlight the need for patients to receive interventions that can alleviate symptoms and prevent exacerbations, to reduce both morbidity and the direct costs associated with the disease. Bronchodilators are the mainstay of treatment for COPD, supported by evidence of improved lung function, symptoms and quality of life. However, bronchodilators are limited in their ability to reduce the frequency and severity of exacerbations, and reducing the risk of exacerbations may require the use of medications that act upon the underlying inflammatory processes of the COPD. Currently, the main strategy recommended by treatment guidelines for the prevention of COPD exacerbations is influenza vaccination, but this intervention was underutilized in the U.S.A. sample, with only 60% of patients in the survey reporting a vaccination in the previous year. Recent evidence suggests that the use of inhaled corticosteroids may also reduce the impact of exacerbations in patients with COPD, but only one-third of patients in the survey reported taking this class of medication.

The direct, indirect and societal costs of COPD in the survey sample were particularly high in patients with severe COPD, which supports previous studies conducted in the U.S.A. (7–8). This suggests that interventions that could effectively delay the progression to severe COPD could reduce the costs of the disease. Encouraging patients to stop smoking in the early stages of COPD is considered to be the single most important intervention for reducing the long-term impact of the disease on the patient and society. In this survey, former smokers were more costly to the healthcare system and the economy than current smokers. However, this may reflect differences in disease severity and the impact of the 'quitting ill' effect, in which smokers quit upon developing disease symptoms or immediately after diagnosis of smoking-related diseases (20).

The survey showed that patients with COPD and other serious or chronic conditions are more costly to the healthcare system and society than patients with COPD alone. This supports the results of previous studies, which have shown that a significant proportion of the direct cost of COPD in the U.S.A. is associated with patients who have comorbid illness (e.g. coronary heart disease, congestive heart failure, hypertension, or malignant disease), with costs rising with the number of comorbidities (8–9). For example, an analysis of data from patients enrolled in a health maintenance organization revealed that per patient cost of inpatient care for a COPD patient with comorbidity was more than twice as high as the cost of equivalent care for a patient with COPD alone (US$5093 versus US$2026) (9). Outpatient care and pharmacy costs were also higher in patients with comorbidity than controls (US$5042 versus US$3050 and US$1545 versus US$739 per patient, respectively). Therefore, reducing the number of comorbidities that a patient may develop could significantly alleviate the burden of COPD in the U.S.A. Smoking cessation is likely to have a role to play here, as in addition to delaying disease progression, this intervention reduces the risk of a patient developing conditions such as coronary artery disease and cancer (9).

CONCLUSION

In the U.S.A., the yearly costs of COPD to the healthcare system and society are considerable, estimated from this survey to be over US$5600 per patient. The majority of disease costs in the survey were associated with unscheduled care, specifically inpatient hospitalizations, suggesting that improving the long-term management of the disease in primary care could reduce the burden of disease. Improving disease management in the U.S.A. may require an increase in the availability and usage of interventions that can prevent exacerbations, reduce the risk of hospitalizations, improve symptom control, delay disease progression and reduce the risk of comorbidities in patients with COPD.

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